Process-based metrics developed in the framework of the PRIMAVERA project

Etienne Tourigny<etienne.tourigny@bsc.es>, Javier Vegas, Elefteria Exarchou, Valentina Sicardi, Javier Garcia Serrano, Francisco J. Doblas Reyes, Virginie Guemas, Neven Fuckar, Louis-Philippe Caron (BSC, Barcelona, Spain)

Metric for Ocean Heat Content - Eleftheria Exarchou (BSC)

We have developed a metric to evaluate the model's ability to reproduce the observed amplitude of the interannual variability in OHC, expressed as a relative error of standard deviation for each separate month. We have applied this metric to EC-Earth3.1, where we compare the standard deviation of the globally integrated OHC of the top 300 m of the ocean to ORAS4 reanalysis (Figures 1 and 2). EC-Earth clearly underestimates the OHC variability, particularly in summer , by up to 20%. We have also extended this metric so as to calculate the pattern correlation for the 2D OHC (vertically integrated OHC). An example for EC-Earth3.1 and ORAS4 is shown in Figure 3.

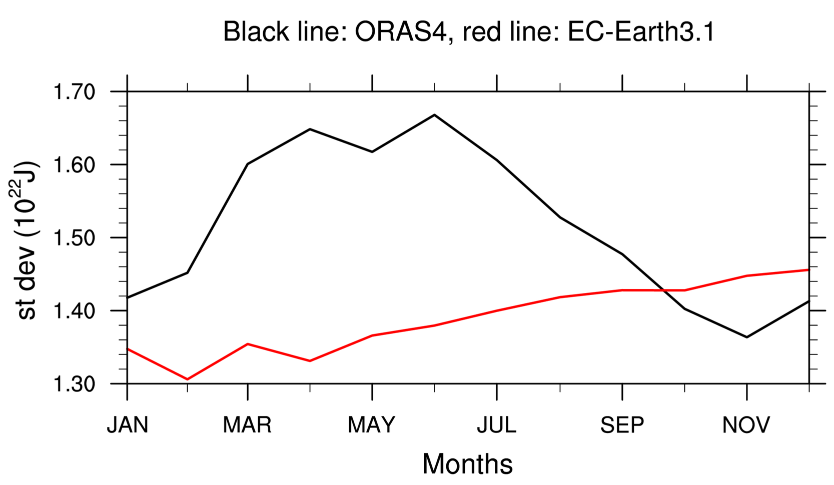


Figure 1: Standard deviation (computed over years 1960-1978) for ORAS4 and EC-Earth3.1

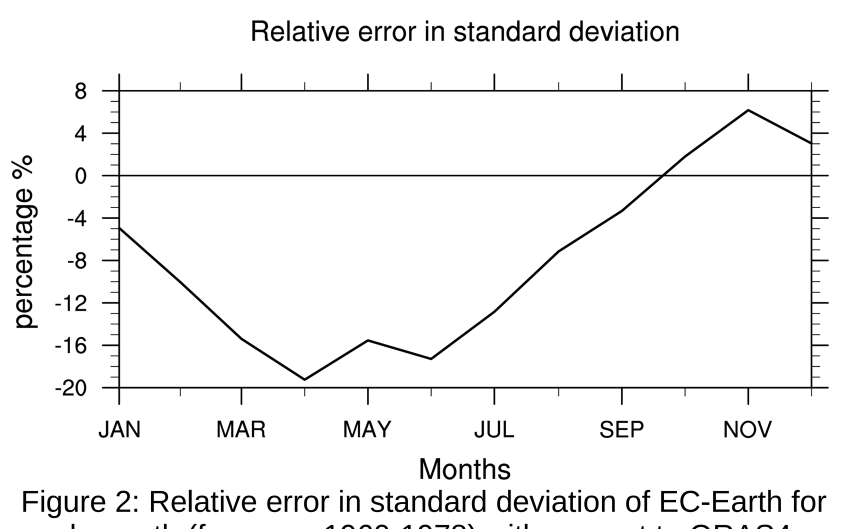


Figure 2: Relative error in standard deviation of EC-Earth for each month (for years 1960-1978) with respect to ORAS4.

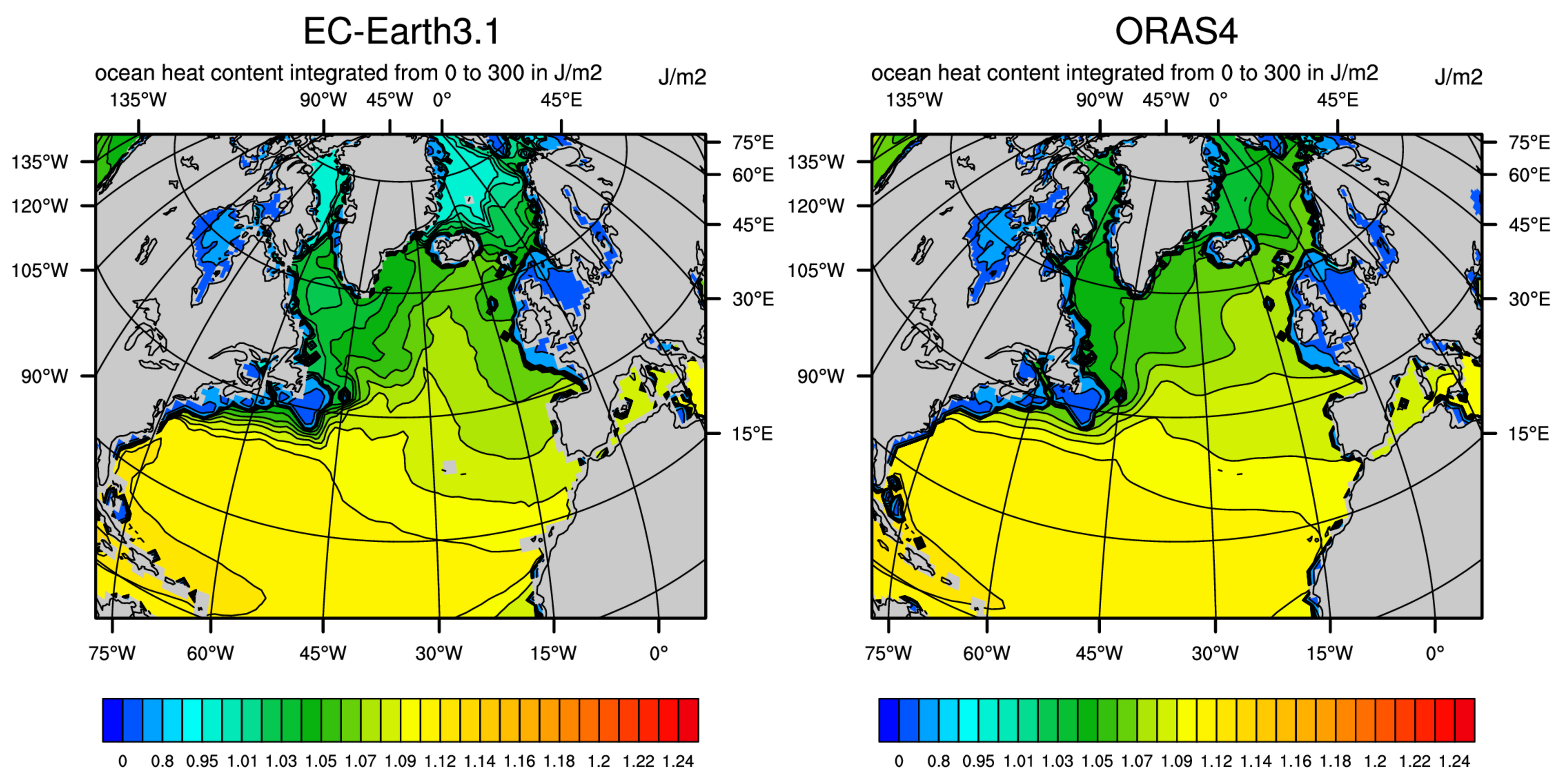
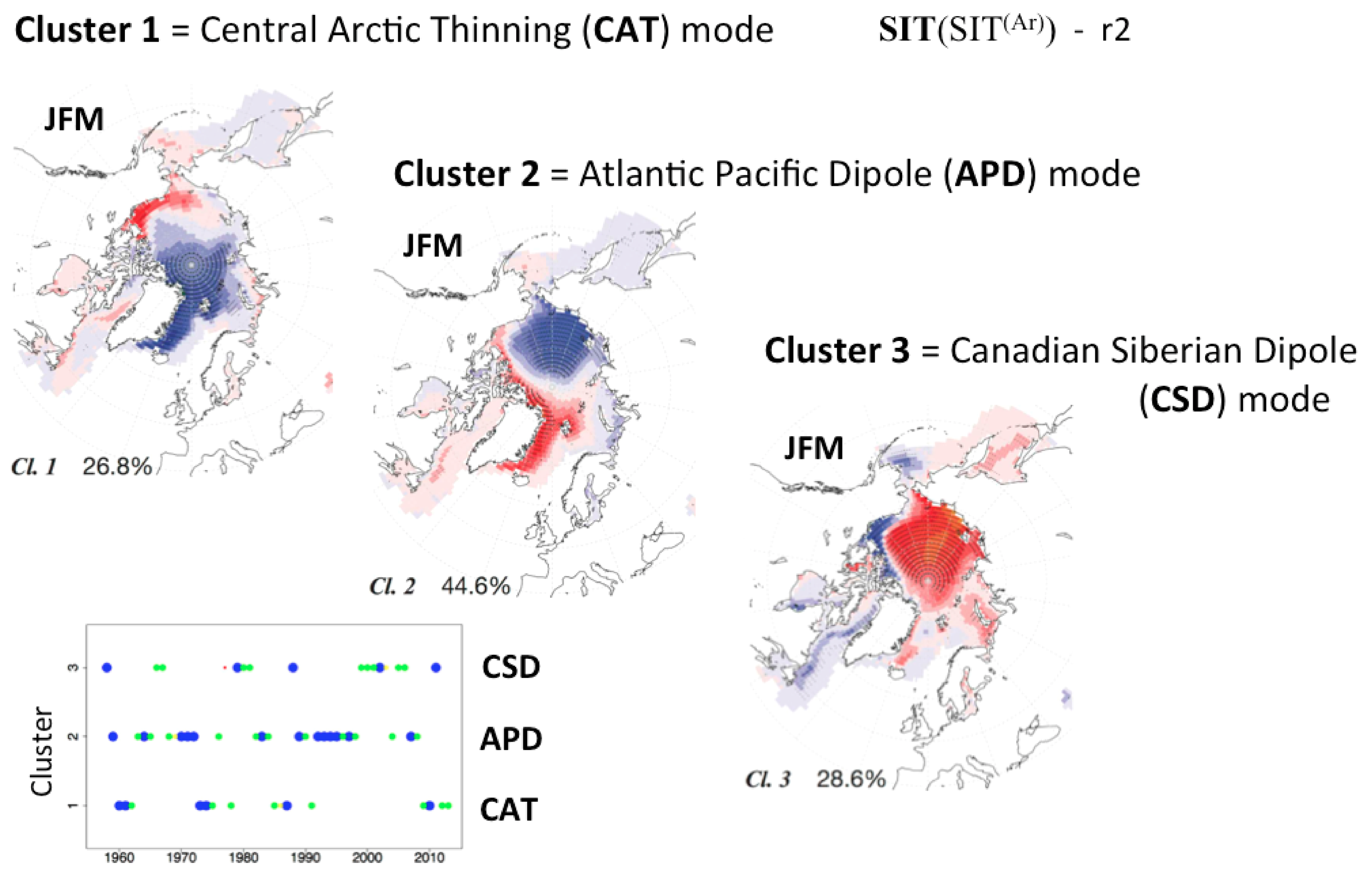


Figure 3: Spatial patterns of OHC (vertically integrated between 0-300 m, in 1011 J/m2, time mean of 1960-1978, scaled so that the OHC means are equal to 1011 J/m2). EC-Earth3.1 data

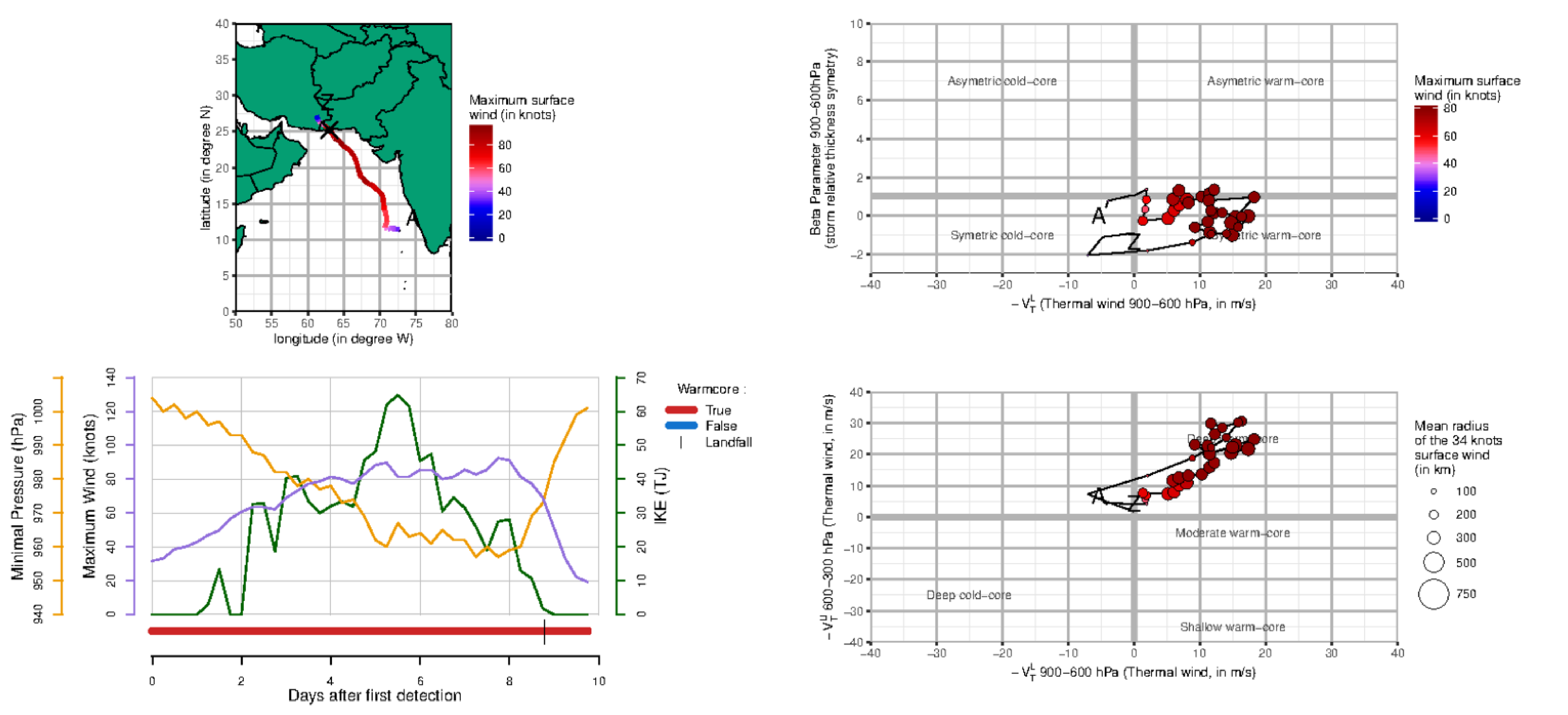
Sea ice thickness clusters: Metric for sea ice variability - Neven S. Fuckar (BSC)

We have developed R-based set of tools to perform K-means cluster analysis of sea ice thickness (SIT) field to examine interannual variability of Arctic sea ice cover unconstrained by inherent assumptions of the principal component analysis (such as symmetry between positive and negative phases, linear covariance matrix, etc.). SIT has the potential to contain a key source of climate predictability on seasonal to interannual and longer time scales in the Arctic. It is shown that due to nonlinear response of Arctic sea ice cover to forced climate change we have to remove a 2nd order polynomial approximation of long-term climate change to determine robust K-means patterns of SIT variability and the associated time series of cluster occurrences. We have determined that the optimal number of Arctic SIT cluster from 1958 to 2013 is 3 and that cluster patterns are rather consistent across different months and different seasons.



Metric for Tropical cyclones - Louis-Philippe Caron (BSC)

We installed on Jasmin a tool to detects the formation and propagation of tropical cyclones in climate simulations. The core tracking algorithm is derived from the GFDL Vortex Tracker V3.5b, which was modified to serve the current purposes and architecture, and was complemented with some post-processing tools. The tracker provides an estimate of the cyclone center position along with metrics for intensity and structure, using mean sea level pressure, wind velocity, vorticity, geopotential height and temperature. Instructions on how to use the software are available as well.



ENSO metrics derived from NCAR's Climate Variability Diagnostics Package (CVDP) – Etienne Tourigny (BSC)

The Climate Variability Diagnostics Package (CVDP) developed by NCAR's Climate Analysis Section is an analysis tool that documents the major modes of climate variability in models and observations. The tool has been integrated into the ESMValtool which is available on the JASMIN platform. The CVDP diagnostics was used to evaluate several pre-PRIMAVERA model simulations (EC-Earth, EC-Earth-HR, CERFACS-HR, HadGEM3-GC2-N96O025, HadGEM3-GC2-N216O025), using data prepared by Martin Evaldsson (SMHI).

Figure 1 shows the standard deviation of DJF Sea Surface Temperature (SST) from HadISST1, compared to the model results. Note that the different datasets span different years, making comparisons difficult. Several unsuccessful attempts were made to run the diagnostics for a common period (1979-2005) showing that further work is required to increase the performance and user-friendliness of the CVDP package as installed on the JASMIN platform.

Figure 2 shows the power spectra of detrended monthly SSTs over the Niño 3.4 region. Results show that the CERFAC-HR simulation most closely matches observations. Note that the power spectra of the EC-Earth High Resolution (HR) simulation is slightly more realistic than the lower resolution simulation, but greatly underestimates the lower frequency components such as ENSO and PDO.

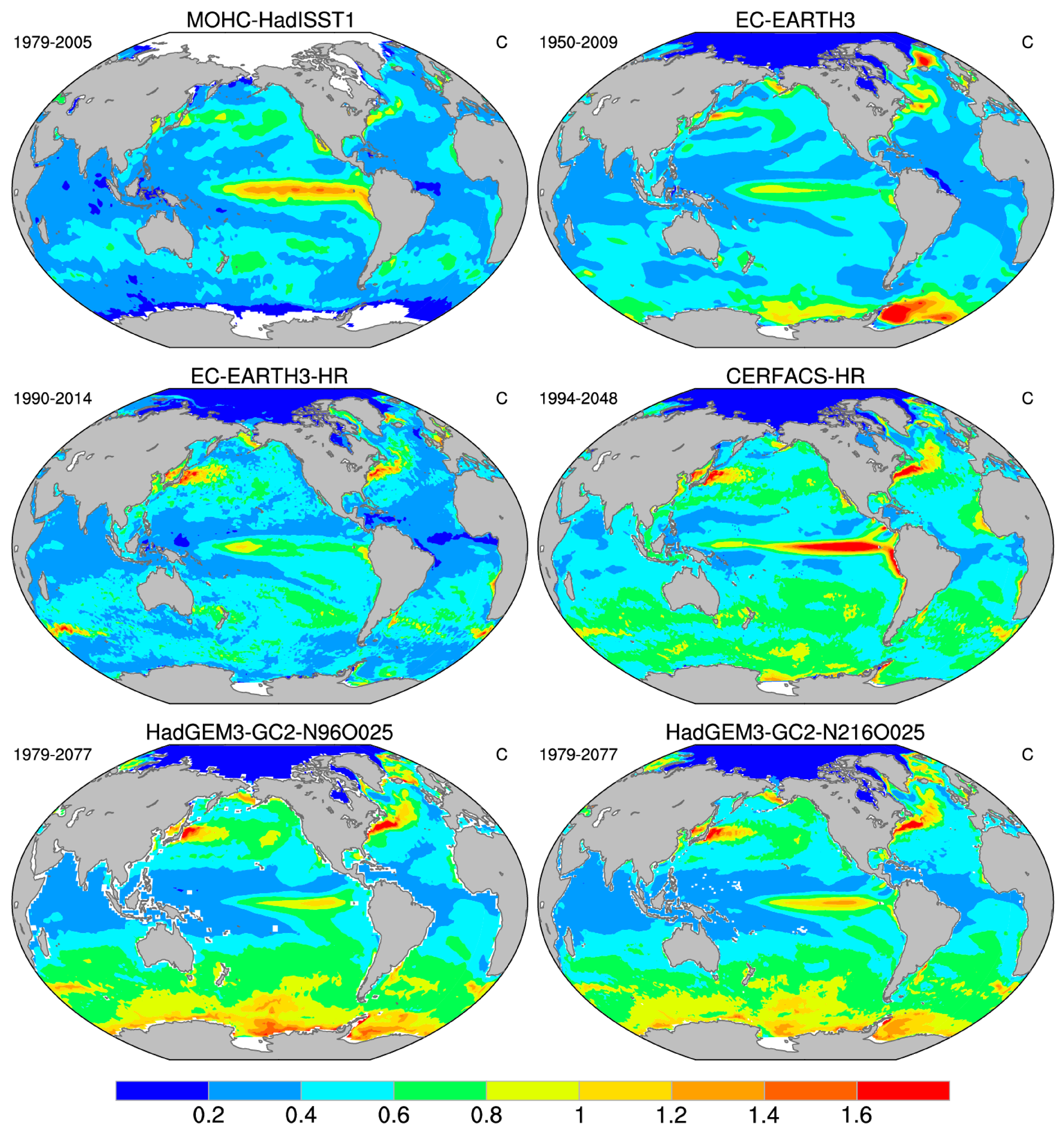


Figure 1 : standard deviation of DJF Sea Surface Temperature (SST) for observations and model output.

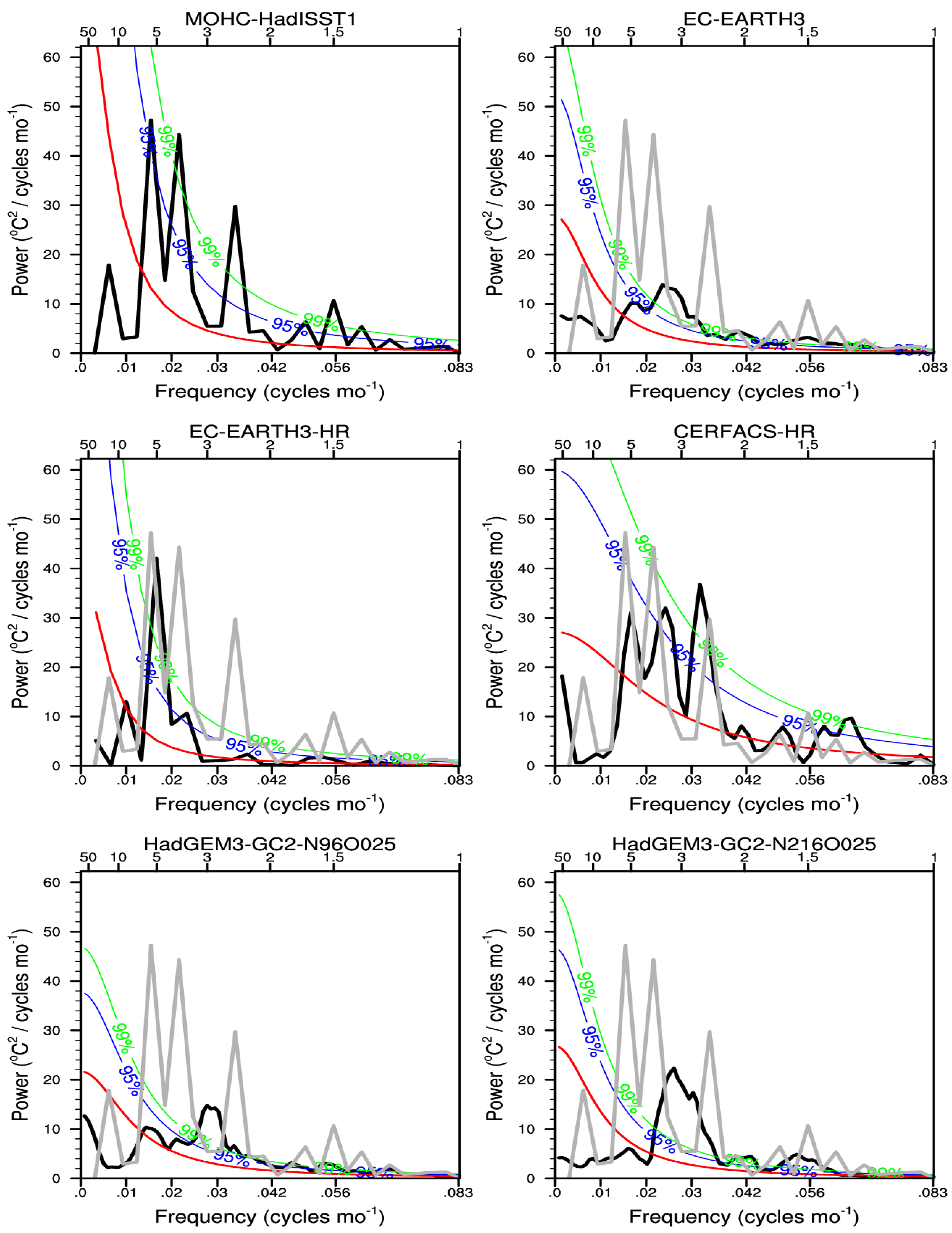


Figure 2 : Niño 3.4 region power spectra of observations and modeled SST.